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FACTORS FOR CONVERTING LOG AND TREE VOLUMES OR VALUES FROM ONE COMMON SCALE TO ANOTHER

by

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The Occasional Papers of the Southern Forest Experiment Station present information on current southern forestry problems under investigation at the Station. In some cases these contributions were first presented as addresses to a limited group of people, and as "occasional papers" they can reach a much wider audience. In other cases, they are summaries of investigations prepared especially to give a report of the progress made in a particular field of research. In any case, the statements herein contained should be considered subject to correction or modification as further data are obtained.

FACTORS FOR CONVERTING LOG AND TREE VOLUMES OR VALUES FROM ONE COMMON SCALE TO ANOTHER [1/]

by

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Since trees are cut into many products, which are measured by any one of several log rules, by the piece or by cubic content, those who deal with forests or forest products have numerous occasions to convert log or tree volumes from one unit of measurement to another, or to convert the value or cost of a thousand board feet of logs or timber from Doyle scale to International ($\frac{1}{4}$-inch kerf) or Scribner scale. Also it is often desirable to know how many cubic feet or cords of pulpwood are equivalent to a thousand board feet of timber from trees of given diameters.

Because of the demand for information that will permit rapid calculations similar to those indicated, the following tables are given, based on the measurement of 500,000 board feet in 874 logs and 1,207 trees, measured by Doyle scale, Scribner scale, International scale, and in cubic feet. As is stated in the tables, the values and converting factors for the logs were based on 16-foot logs only, while the values and converting factors for trees were based on the portions of the trees actually used or merchantable, regardless of the lengths of logs cut.

Uses of table 1

1. If the diameter inside bark of a 16-foot log is given, one can read off directly the volume of the log in board feet by the Doyle, Scribner, or International scales, and also the volume in cubic feet.

2. If the log-scale volume of a 16-foot log is given in any one of the three scales or in cubic feet, one can read off directly the equivalent volume in the other measurement systems.

3. If the log volume of a 16-foot log is given, one can read off directly the diameter inside bark at the small end of the log.

4. If the cost is given of felling and bucking, or skidding and loading, etc., per M feet in the International scale, one can determine the cost per M feet in a different scale. Example: If the cost of felling and bucking per M feet International scale for logs with a top diameter of 12-inches inside bark or 97 board feet is 60¢, what is the corresponding cost for logs of the same size in Doyle scale? From table 1 the converting factor from International scale to Doyle scale for logs of this size is seen to be 0.6598. Then the cost of the felling and bucking in Doyle scale is equal to 60¢ ÷ 0.6598 or 91¢ per M feet.

1/ From a study of selective logging in southeastern Arkansas.

5. If the cost is given of felling and bucking, etc., per M feet based on a scale other than International, one can determine the cost in the International scale by multiplying this cost by the proper converting factor, as given in the table. Example: If the cost of felling and bucking by Doyle scale is 91¢ per M feet for logs averaging 64 board feet per log, what is the corresponding cost in International scale? From table 1 it is seen that logs of this size have a converting factor of 0.6598. Then the cost of felling and bucking in International scale is 91¢ x 0.6598 or 60¢ per M feet.

6. If the cost is given of felling and bucking, etc., per M feet for logs of a given size based on either Doyle or Scribner, one can determine the cost in the other scale (Scribner or Doyle, respectively) by multiplying the value by the proper converting factor to obtain the value in the International scale, and then dividing by the converting factor for the size and log scale desired. Example: The cost of skidding and loading pine logs containing 100 feet log scale (Doyle) is 72¢ per M feet, what is the cost per M feet Scribner scale? 72¢ x 0.7353 = 53¢ or the cost per M feet International scale. Then 53 ÷ 0.9044 = 59, or the cost in cents per M feet Scribner scale.

Table 1 may also be used in the following ways for approximately correct results:

1. All the uses described above of table 1 are based on 16-foot logs, but the table may also be used in the same ways even if the logs are longer or shorter than this, without an error (generally) of more than 6 percent.

2. Although the data in table 1 are based on a study of shortleaf and loblolly pine in Southeast Arkansas, this table is applicable to any species of southern pine with a similar taper. Logs having a taper different from that on which the study was based, however, would not have the same cubic-foot volumes and ratios, although in most such cases the error involved would probably not be serious.

3. Table 1 has been prepared for use with individual 16-foot logs of known diameter, but it can also be used for converting volumes or values from one scale to another when the average dimensions of a large number of logs are known. If the logs had little variation in length and diameter, the error involved would not be large, but if the diameters of the logs ranged from 6 to 15 or 20 inches, the error in volumes or values could amount to as much as 15 or 20 percent.

Uses of table 2

Table 2 gives the merchantable volume per tree in board feet by three common log scales, the number of cubic feet (of logs) per tree, the number of cubic feet per M board feet for trees of various diameters, and factors for converting cost or other values from one common log scale to another. Although this table applies specifically to shortleaf and loblolly pine in Southeast Arkansas, it can be applied to these two species growing elsewhere or to other pines in this and other regions having similar taper, log lengths, and upper limits of utilization.

This table has the same use for converting costs or values of trees that table 1 has for converting costs or values of logs. The discussion of possible uses of table 1 given above will apply directly to this table, therefore, if the word "tree" is substituted for the word "log".

Table 1

Converting Factors for 16-foot Shortleaf and Loblolly Pine Logs in Southeast Arkansas

Diameter (inside bark) small end of log	Board feet per log (International scale)	Equivalent in			To convert values per M bd. ft. based on International scale to values based on Doyle scale, Scribner scale, or cubic feet, divide by the following figures 2/			Number of cubic feet peeled volume per M board feet when scaled by		
		Doyle scale 1/ (board feet)	Scribner scale 1/ (board feet)	Cubic feet (inside bark)	Doyle scale	Scribner scale	Cubic feet	International scale	Doyle scale	Scribner scale
Inches					Ratios					
6.0	19	4	12	4.0	0.2105	0.6316	0.2105	210.5	1000.0	333.3
6.5	23	6	16	4.4	.2609	.6956	.1913	191.3	733.3	275.0
7.0	28	9	21	5.0	.3214	.7500	.1786	178.6	555.6	238.1
7.5	33	12	25	5.6	.3636	.7576	.1697	169.7	466.7	224.0
8.0	39	16	31	6.3	.4102	.7949	.1615	161.5	393.8	203.2
8.5	45	20	36	7.1	.4444	.8000	.1578	157.8	355.0	197.2
9.0	51	25	42	7.9	.4902	.8235	.1549	154.9	316.0	188.1
9.5	58	30	48	8.8	.5172	.8276	.1517	151.7	293.3	183.3
10.0	65	36	55	9.8	.5538	.8462	.1508	150.8	272.2	178.2
10.5	72	42	62	10.8	.5833	.8611	.1500	150.0	257.1	174.2
11.0	80	49	70	11.8	.6125	.8750	.1475	147.5	240.8	168.6
11.5	88	56	78	12.9	.6364	.8864	.1466	146.6	230.4	165.4
12.0	97	64	86	14.2	.6598	.8866	.1464	146.4	221.9	165.1
12.5	106	72	94	15.4	.6792	.8868	.1453	145.3	213.9	163.8
13.0	115	81	104	16.7	.7043	.9043	.1452	145.2	206.2	160.6
13.5	125	90	113	17.9	.7200	.9040	.1432	143.2	198.9	158.4
14.0	136	100	123	19.2	.7353	.9044	.1412	141.2	192.0	156.1
14.5	146	110	133	20.5	.7534	.9110	.1404	140.4	186.4	154.1
15.0	157	121	144	22.0	.7707	.9172	.1401	140.1	181.8	152.8
15.5	169	132	155	23.5	.7811	.9172	.1390	139.0	178.0	151.6
16.0	181	144	166	25.0	.7956	.9171	.1381	138.1	175.6	150.6
16.5	193	156	178	26.7	.8083	.9223	.1383	138.3	171.2	150.0
17.0	205	169	190	28.4	.8244	.9268	.1385	138.5	168.0	149.5
17.5	219	182	203	30.2	.8310	.9269	.1379	137.9	165.9	148.8
18.0	232	196	216	32.0	.8448	.9310	.1379	137.9	163.5	148.1
18.5	246	210	229	33.9	.8536	.9309	.1378	137.8	161.4	148.0
19.0	260	225	243	35.8	.8654	.9346	.1377	137.7	159.1	147.3
19.5	275	240	257	37.8	.8727	.9345	.1374	137.4	157.5	147.1
20.0	290	256	272	39.8	.8828	.9379	.1372	137.2	155.5	146.3
20.5	305	272	287	41.8	.8918	.9410	.1370	137.0	153.7	145.6
21.0	321	289	302	43.8	.9003	.9408	.1364	136.4	151.6	145.0
21.5	337	306	318	45.8	.9080	.9436	.1359	135.9	149.7	144.0
22.0	354	324	334	47.8	.9152	.9435	.1350	135.0	147.5	143.1

1/ Doyle scale is computed from the formula: $V = \frac{(D-4)^2 \times L}{16}$

Scribner scale is computed from the formula: $V = 0.79D^2 - 2D - 4$

International $\frac{1}{4}$-inch scale is computed from the formula: $V = 0.796D^2 - 1.375D - 1.230$

2/ To convert board feet in the International scale to board feet Doyle scale or Scribner scale, or to cubic feet, multiply by the given values.

Table 2

Converting Factors for Shortleaf and Loblolly Pine Trees in Southeast Arkansas

D.B.H. (outside bark)	Merchantable board feet per tree (International scale)	Equivalent in			To convert values per M bd. ft. based on International scale to values based on Doyle scale, Scribner scale, or cubic feet, divide by the following figures [1]			Number of cubic feet per M board feet when scaled by		
		Doyle scale (board feet)	Scribner scale (board feet)	Cubic feet (inside bark)	Doyle scale	Scribner scale	Cubic feet	International scale	Doyle scale	Scribner scale
Inches					Ratios					
10	53	20	32	13.1	0.3774	0.6038	0.2472	247.2	655.0	409.4
11	79	38	56	14.7	.4810	.7089	.1861	186.1	386.8	262.5
12	107	58	82	17.0	.5421	.7664	.1589	158.9	293.1	207.3
13	137	81	113	20.1	.5912	.8248	.1467	146.7	248.1	177.9
14	168	108	146	24.1	.6429	.8690	.1435	143.5	223.1	165.1
15	202	141	182	29.3	.6980	.9010	.1450	145.0	207.8	161.0
16	239	176	219	34.9	.7364	.9163	.1460	146.0	198.3	159.4
17	280	213	257	41.0	.7607	.9179	.1464	146.4	192.5	159.5
18	325	253	298	47.7	.7785	.9169	.1468	146.8	188.5	160.1
19	375	297	342	55.1	.7920	.9120	.1469	146.9	185.5	161.1
20	431	344	392	62.7	.7981	.9095	.1455	145.5	182.3	159.9
21	492	400	449	70.8	.8130	.9126	.1439	143.9	177.0	157.7
22	561	465	513	79.3	.8289	.9144	.1414	141.4	170.5	154.6
23	631	541	585	88.1	.8574	.9271	.1396	139.6	162.8	150.6
24	706	621	662	97.0	.8796	.9377	.1374	137.4	156.2	146.5
25	785	705	743	105.9	.8981	.9465	.1349	134.9	150.2	142.5
26	867	790	827	114.9	.9112	.9539	.1325	132.5	145.4	138.9
27	950	876	913	124.0	.9221	.9611	.1305	130.5	141.6	135.8
28	1,033	963	1,000	133.0	.9322	.9681	.1288	128.8	138.1	133.0
29	1,116	1,050	1,090	142.0	.9409	.9767	.1272	127.2	135.2	130.3
30	1,200	1,140	1,182	151.0	.9500	.9850	.1259	125.8	132.5	127.7

1/ To convert board feet in the International scale to board feet Doyle scale or Scribner scale, or to cubic feet, multiply by the given values.